University of Engineering and Management

Institute of Engineering & Management, Salt Lake Campus

5th Semester Syllabus for B.Tech
(Admission Batch 2023)

Electrical & Electronics Engineering									
B.Tech. 3rd Year Course Structure									
5th Semester									
Sl No	**Type of Course**	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**S**	**Total Conta**	**Credit Points**
Theory									
1	Professional Core Courses	PCC-EEE 501	Electric machine-II	2	1	0		3	3
2	Professional Core Courses	PCC-EEE 502	Power System-I	2	1	0		3	3
3	Professional Core Courses	PCC-EEE 503	Control system	2	1	0		3	3
4	Humanities and social sciences including Management	PCC-EEE 504	Power Electronics	2	1	0		3	3
5	Professional Elective Courses	PEC-EEE 571	A: Electric Vehicles / B:Renewable & Non Conventional Energy	3	0	0		3	3
6	Open Elective Courses	OEC-EEE 501	A:AI & Machine Learning/ B:Computer Organization/ C:Industrial Automation I	3	0	0		3	3
7	Humanities and social sciences including Management	ESP(EE)501	Essential Studies For Professionals V	2	0	0		2	0.5
PRACTICAL									
8	Professional Core Courses	PCC-EEE 591	Electric Machine Laboratory-II	0	0	3		2	1
9	Professional Core Courses	PCC-EEE 592	Control System Lab	0	0	3		2	1
10	Professional Core Courses	PCC-EEE 593	Power Electronics Lab	0	0	3		2	1
11	Professional Elective Courses	PEC-EEE 591	A: Electric Vehicles Lab/ B: Renewable Lab & Non Conventional Energy	0	0	3		2	1
SESSIONAL									
12	Humanities and social sciences including Management	SDP581	Skill Development For Professionals V				2	2	0.5
13	Project. Seminar and Industrial Training	PW-EEE 03	Mini Project III				0	1	1
Value Added Courses									
14	Massive Open Online Courses (MOOCs)	MOOCS	Massive Open Online Courses (MOOCs)						
15	Industry and Foreign Certification (IFC)	IFC	Industry and Foreign Certification (IFC)						
16	Mandatory Additional Requirements (MAR)	MAR581	Mandatory Additional Requirements (MAR)						
Total Credit Points of Semester				**16**	**4**	**12**	**2**	**31**	**24**

University of Engineering and Management

Institute of Engineering & Management, Salt Lake Campus
Institute of Engineering & Management, New Town Campus
University of Engineering & Management, Jaipur

Syllabus for B.Tech Admission Batch 2023

Subject Name: Electrical Machine-II **Credit: 3**
Lecture Hours: 40 **Subject Code: PCC-EEE-501**

Study Material	Coursera:	Nptel:	LinkedIn Learning	Infosys Springboard

Maximum: 100 marks (Internal: 30 marks; External: 70 marks)

List of Faculty Members handling the Subject –

1. Prof. Nirban Chakraborty

Pre-requisite: PCCEEE401

Course Objective:

The purpose of learning this course is

1. To understand the arrangement of windings of AC machines
2. To understand the principle of production of pulsating and revolving magnetic fields
3. To understand the principle of operation and characteristics of three phase Induction machines
4. To understand the principle of operation and characteristics of single phase Induction machines
5. To understand the principle of operation and characteristics of synchronous machine
6. To understand the principle of operation and characteristics of special electromechanical devices
7. To solve problems of Induction machines, synchronous machines and special eletromechanical devices

Detailed Syllabus:

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Text Book	Mapped Chapter
1	Fundamentals of AC machine	Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single-turn coil -active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, Air-gap MMF distribution with fixed current through winding-concentrated and distributed, Sinusoidally distributed winding, winding distribution factor.	**Academia Mapping:** https://ocw.mit.edu/courses/6-685-electric-machines-fall-2013/ https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_Electrical_Engg.pdf **Industry Mapping:** MATLAB	2	1. Design of different windings used in Electrical Machines using MATLAB.	Electric Machines, by DP Kothari & IJ Nagrath, 4th Edition, McGraw Hill	Chapter 5
2	Pulsating and revolving magnetic fields	Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding -fixed current and alternating current Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.	**Academia Mapping:** https://ocw.mit.edu/courses/6-685-electric-machines-fall-2013/ https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_Electrical_Engg.pdf **Industry Mapping:** MATLAB	2		Electric Machines, by DP Kothari & IJ Nagrath, 4th Edition, McGraw Hill	Chapter 5

3	Induction Machines	Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines. Solution of different problems	**Academia Mapping:** https://ocw.mit.edu/courses/6-685-electric-machines-fall-2013/ https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_Electrical_Engg.pdf **Industry Mapping:** MATLAB, Induction Machine Set	13	1. Application of different starter for maintaining the stable operation of a 3 phase Cage Induction Motor [DOL, Auto transformer & Star-Delta]. 2. Design of an 18 slot squirrel cage Induction motor for 6 poles & 4 pole operation in full pitch & fractional slot winding diagram. 3. Speed control of 3 phase squirrel cage induction motor by different methods & their comparison [voltage control & frequency control] for industrial application. 4. Evaluate the performance characteristics of wound rotor Induction motor for industrial hoist application. 5. PLC and AC Drive based speed control of induction motor with Human Machine Interface. 6. Design a simulation model for evaluating the optimal characteristics of Three Phase Induction Motor Controlled by AC Voltage Controller in MATLAB Simulink. 7. Design a MATLAB Simulation model for 3 phase Induction Motor Torque Speed Characteristics.	Electrical Machines, by Prithwiraj Purkait & Indrayudh Bandopadhyay, 1st Edition, Oxford University Press.	Chapter 8, 9, 10

4	Single-phase induction motors:	Constructional features double revolving field theory, equivalent circuit, and determination of parameters. Split-phase starting methods and applications	**Academia Mapping:** https://ocw.mit.edu/courses/6-685-electric-machines-fall-2013/ https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_Electrical_Engg.pdf **Industry Mapping:** MATLAB, Single Phase Induction Machine Set	5	1. Test of single phase induction motor for centrifugal pump application.. 2. Design the equivalent circuit of single phase induction motor for different domestic application.	Electrical Machines, by Prithwiraj Purkait & Indrayudh Bandopadhyay, 1st Edition, Oxford University Press.	Chapter 14
5	Synchronous machines	Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous motor, V-curves. Salient pole machine –two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators – synchronization and load division. Solution of different problems	**Academia Mapping:** https://ocw.mit.edu/courses/6-685-electric-machines-fall-2013/ https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_Electrical_Engg.pdf **Industry Mapping:** MATLAB, Synchronous Machine Set	14	1. Design a equivalent circuit for synchronous machine for analyzing the machine performance using industrial testing procedure [Direct axis resistance (Xd) & Quadrature reactance (Xq)].. 2.Determination of voltage regulation of Synchronous machine by a. Synchronous Impedance method at different power factor. 3. Evaluate the optimize performance criteria for different industrial load application of Synchronous motor using V-curve method.	Electrical Machines, by Prithwiraj Purkait & Indrayudh Bandopadhyay, 1st Edition, Oxford University Press.	Chapter 11, 12, 13
6	Special Electromechanical devices	Principle and construction of switched Reluctance motor, Induction Generator, Hysteresis motor, Tacho generators.	**Academia Mapping:** https://ocw.mit.edu/courses/6-685-electric-machines-fall-2013/ https://www.aicte-india.org/downloads/MODEL_SYLLABI_FOR_UG_Electrical_Engg.pdf **Industry Mapping:** MATLAB, Induction Machine Set	4	1. Performance verification of Induction generator for wind mill application. 2. Design a simulation model for determining the characteristics of Self Excited Induction Generator in MATLAB Simulink	Electrical Machines, by Prithwiraj Purkait & Indrayudh Bandopadhyay, 1st Edition, Oxford University Press.	Chapter 15

Lesson Plan:

Module 1: **Fundamentals of AC machine Year 2025 (Faculty: Mr. NIRBAN CHAKRABORTY)**

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single-turn coil -active portion and overhang; full-pitch coils, concentrated winding, distributed winding.
2	Winding axis, Air-gap MMF distribution with fixed current through winding-concentrated and distributed, Sinusoidally distributed winding, winding distribution factor.

Module 2: **Pulsating and revolving magnetic fields, Year 2025 (Faculty: Mr. NIRBAN CHAKRABORTY)**

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Constant magnetic field, pulsating magnetic field -alternating current in windings with spatial displacement, Magnetic field produced by a single winding -fixed current and alternating current Pulsating fields produced by spatially.
2	Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

Module 3: **Induction Machines, Year 2025 (Faculty: Mr. NIRBAN CHAKRABORTY)**

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Construction, Types (squirrel cage and slip-ring).
2	Torque Slip Characteristics, Starting and Maximum Torque.
3	Torque Slip Characteristics, Starting and Maximum Torque.
4	Equivalent circuit. Phasor Diagram, Losses and Efficiency.
5	Equivalent circuit. Phasor Diagram, Losses and Efficiency.
6	Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency).
7	Methods of starting, braking and speed control for induction motors.
8	Methods of starting, braking and speed control for induction motors.
9	Generator operation. Self-excitation
10	Doubly-Fed Induction Machines
11	Solution of different problems
12	Solution of different problems
13	Solution of different problems

Module 4: **Single-phase induction motors, Year 2025 (Faculty: Mr. NIRBAN CHAKRABORTY)**

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Constructional features double revolving field theory.
2	Constructional features double revolving field theory.
3	Equivalent circuit, and determination of parameters
4	Equivalent circuit, and determination of parameters
5	Split-phase starting methods and applications.

Module 5: **Synchronous machines, Year 2025 (Faculty: Mr. NIRBAN CHAKRABORTY)**

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Constructional features, cylindrical rotor synchronous machine -generated EMF
2	Constructional features, cylindrical rotor synchronous machine -generated EMF
3	Equivalent circuit and phasor diagram, armature reaction
4	Equivalent circuit and phasor diagram, armature reaction
5	Equivalent circuit. Phasor Diagram, Losses and Efficiency.
6	Synchronous impedance, voltage regulation
7	Operating characteristics of synchronous motor, V-curves
8	Operating characteristics of synchronous motor, V-curves
9	Operating characteristics of synchronous motor, V-curves
10	Salient pole machine –two reaction theory, analysis of phasor diagram
11	Salient pole machine –two reaction theory, analysis of phasor diagram
12	Power angle characteristics
13	Parallel operation of alternators – synchronization and load division.
14	Solution of different problems

Module 6: **Special Electromechanical devices, Year 2025 (Faculty: Mr. NIRBAN CHAKRABORTY)**

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Principle and construction of switched Reluctance motor
2	Induction Generator
3	Induction Generator
4	Hysteresis motor, Tacho generators.

Course Outcome:

After completion of this course, the learners will be able to

CO1. Describe the arrangement of winding of AC machines.
CO2. Explain the principle of operation and solve numerical problems of Induction machines, Synchronous machines and special machines.
CO3. Estimate the parameters, characteristics and efficiency of Induction machines and Synchronous machines.
CO4. Select appropriate methods for starting, braking and speed control of Induction machines.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	2	0	0	3	0	0	0	0	0	0
CO 2	3	3	3	2	2	2	3	0	0	0	0	1
CO 3	3	1	3	3	2	1	1	0	1	0	0	1
CO 4	3	2	0	2	0	0	2	0	0	0	0	0

Suggested Learning Resources:

Text Books:

1. Electrical Machines, by Prithwiraj Purkait & Indrayudh Bandopadhyay, 1st Edition, Oxford University Press.

2. Electric Machines, by DP Kothari & IJ Nagrath, 4th Edition, McGraw Hill.

Reference Books:

1. Electrical Machines, Theory & Applications, M.N. Bandyopadhyay, PHI
2. Electric Machinery & Transformer, Bhag S. Guru and H.R. Hiziroglu, 3rd Edition, Oxford University press.
3. Electric Machinery & Transformes, Irving L. Kosow, PHI
4. Electric Machinery, A.E.Fitzgerald, Charles Kingsley,Jr. & Stephen D. Umans, 6th Edition, Tata McGraw Hill Edition.
5. Electrical Machines, R.K. Srivastava, Cengage Learning
6. Theory of Alternating Current Machinery, Alexander S Langsdorf, Tata Mc Graw Hill Edition
7. Electric Machines, Charles A. Gross, CRC press.
8. Problems in Electrical Engineering, Parker smith, 9th Edition, CBS publishers & distributors.

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University of Engineering & Management, Jaipur

Syllabus and Lesson Plan for B.Tech Admission Batch 2023

Subject Name: POWER SYSTEM-I **Credit: 3** **Lecture Hours: 40**

Subject Code: PCC-EEE-502

Maximum: 100 marks (Internal: 30 marks; External: 70 marks)

List of Faculty Members handling the Subject –

Pre-requisite: Basic Electrical Engineering Laws, Electrostatic and Electromagnetic Field Theory, Electric Circuit Theory, and Engineering Mathematics

Course Objective:

1. To understand the basic principle of generation of Electricity from different sources
2. To find parameters and characteristics of overhead transmission lines and cables.
3. To find different parameters for the construction of overhead transmission line
4. To determine the performance of transmission lines
5. To understand the principle tariff calculation
6. To solve numerical problems on the topics studied.

Course Outcome:

CO1. Understand the basic concept of power system with grid interconnections, restructuring and Micro-grids.
CO2. Realize the concepts of various power system components with their performance and characteristics.
CO3. Evaluate fault currents for different types of faults and the basic protection schemes with circuit breakers and relay systems.
CO4. Appreciate the concepts of DC power transmission and renewable energy generation

Relevant Links:

Study Material	Coursera Hyperlinked	Nptel	LinkedIn Learning:	Infosys Springboard:

Detailed Syllabus:

Module number	Topic	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Text Book	Mapped Chapter
1	**Basic Concepts**: Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids. Generation: Conventional and Renewable Energy Sources. Distributed Energy,Resources. Energy Storage. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems).Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power.	*https://ocw.mit.edu/courses/6-061-introduction-to-electric-power-systems-spring-2011/*	4	-	D. P.Kothari and I. J.Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.	Ch. 1

2	**Power System Components:** Overhead transmission line:Choice of frequency, Choice of voltage, Types of conductors, Inductance and Capacitance of a single phase and three phase symmetrical and unsymmetrical configurations. Bundle conductors. Transposition. Concept of GMD and GMR. Influence of earth on conductor capacitance.Overhead line construction: Line supports, Towers, Poles, Sag, Tension and Clearance, Effect of Wind and Ice on Sag. Dampers. Corona: Principle of Corona formation, Critical disruptive voltage, Visual critical corona discharge potential, Corona loss, advantages & disadvantages of Corona. Methods of reduction of Corona. Insulators: Types, Voltage distribution across a suspension insulator string, String efficiency, Arching shield & rings, Methods of improving voltage distribution across Insulator strings, Electrical tests on line Insulators Cables:Types of cables, cable components, capacitance of single core & 3 core cables, dielectric stress, optimum cable thickness, grading, dielectric loss and loss angle. Performance of lines:Short, medium (nominal, T) and long lines and their representation. A.B.C.D constants, Voltage regulation, Ferranti Effect, Power equations and line compensation, Power Circle diagrams. Per-unit System and per-unit calculations.	*https://ocw.mit.edu/courses/6-061-introduction-to-electric-power-systems-spring-2011/*	19	-	D. P.Kothari and I. J.Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.	Ch. 2, 3, 5, 16, 17,18,19
3	**Fault Analysis:** Method of Symmetrical Components (positive, negative and zero sequences).Balanced and Unbalanced Faults. Representation of generators, lines and transformers in sequence networks. Computation of Fault Currents. Neutral Grounding.	*https://ocw.mit.edu/courses/6-061-introduction-to-electric-power-systems-spring-2011/*	09	-	D. P.Kothari and I. J.Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.	Ch. 9, 10,11
4	**Protection system:** Switchgear: Types of Circuit Breakers. Attributes of Protection schemes, Back-up Protection. Protection schemes (Over-current, directional, distance protection, differential protection) and their application. Generation of Overvoltages: Lightning and Switching Surges. Protection against Over-voltages, Insulation Coordination. Propagation of Surges. Voltages produced by traveling surges. Bewley Diagrams.	*https://ocw.mit.edu/courses/6-061-introduction-to-electric-power-systems-spring-2011/*	08	-	D. P.Kothari and I. J.Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.	Ch. 14, 15

5	**Application of AI in power system**: AI-Powered Generative Design of Circuit Breaker Topologies for Diverse Grid Conditions, Generative AI for Synthesizing Realistic Fault Scenarios to Train and Validate Advanced Directional Protection Algorithms		02			

Lesson Plan:

Module 1: Basic Concepts Year 2025, (Faculty : Dr. Manas Mukherjee)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids.
2	Generation: Conventional and Renewable Energy Sources. Distributed Energy,Resources. Energy Storage
3	Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems).
4	Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power.

Module 2: Power System Components: Year 2025, (Faculty : Dr. Manas Mukherjee)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	**Power System Components:** Overhead transmission line:Choice of frequency, Choice of voltage, Types of conductors.
2	, Inductance and Capacitance of a single phase conductor
3	three phase symmetrical and unsymmetrical configurations. Bundle conductors
4	Transposition. Concept of GMD and GMR.
5	Influence of earth on conductor capacitance.
6	Overhead line construction: Line supports, Towers, Poles,.
7	Sag, Tension and Clearance, Effect of Wind and Ice on Sag. Dampers
8	Corona: Principle of Corona formation, Critical disruptive voltage,
9	Visual critical corona discharge potential, Corona loss, advantages & disadvantages of Corona.
10	Methods of reduction of Corona. Insulators: Types,
11	Voltage distribution across a suspension insulator string,
12	String efficiency, Arching shield & rings,
13	Methods of improving voltage distribution across Insulator strings, ,
14	Electrical tests on line Insulators
15	Cables:Types of cables, cable components,
16	capacitance of single core & 3 core cables, dielectric stress, optimum cable thickness, grading, dielectric loss and loss angle.
17	Performance of lines:Short, medium (nominal, T) and long lines and their representation. A.B.C.D constants, Voltage regulation
18	Ferranti Effect, Power equations and line compensation, Power Circle diagrams. Per-unit System and per-unit calculations.

Module 3: Fault Analysis Year 2025, (Faculty : Dr. Manas Mukherjee)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	**Fault Analysis:** Method of Symmetrical Components (positive, negative and zero sequences).
2	Balanced Faults
3	Unbalanced Faults
4	Representation of generators.
5	lines and transformers in sequence networks
6	Computation of Fault Currents
7	Neutral Grounding

Module 4: Protection system Year 2025, (Faculty : Dr. Manas Mukherjee)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	**Protection system:** Switchgear: Types of Circuit Breakers..
2	Attributes of Protection schemes, Back-up Protection
3	Protection schemes (Over-current, directional, distance protection, differential protection) and their application.
4	Generation of Overvoltages: Lightning and Switching Surges
5	Protection against Over-voltages
6	Insulation Coordination. Propagation of Surges.
7	Voltages produced by traveling surges.
8	Bewley Diagrams.

TEXT BOOK:

1. D. P.Kothari and I. J.Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.

REFERENCE BOOKS:

1. A.R.Bergen and V.Vittal, "Power System Analysis", Pearson Education Inc., 1999.
2. J.Grainger and W.D.Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
3. O.I.Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
4. B.M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G.Strbac, "Electric Power Systems", Wiley, 2012.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	1	3	1	2	2	1	2	1	0	0
CO2	2	3	3	3	2	2	1	1	2	1	1	1
CO3	3	3	3	3	2	1	2	2	2	1	1	1
CO4	2	2	3	2	3	6	3	3	1	2	1	1

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Syllabus for B.Tech Admission Batch 2023-2027

Subject Name: Control Systems Credit: 3 Lecture Hours: 41

Subject Code: PCCEEE503

Study material	Coursera	nptel	LinkedIn Learning	Infosys Springboard

Maximum: 100 marks (Internal: 30 marks; External: 70 marks)

List of Faculty Members handling the Subject –

1. Arijita Das
2. Neeta Sahay

Pre-requisite: Mathematics, Signals and Systems, Electric Circuit Theory

Course objectives:

The purpose of learning this course is

1. To find mathematical representation of LTI systems
2. To find time response of LTI systems of different orders
3. To findthe frequency response of LTI systems of different orders
4. To understand stabilityof differentLTI systems
5. To analyze LTIsystems with state variables
6. To solve problems of mathematical modelling and stability of LTI systems

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	TEXT BOOK	Mapped Chapter
1	**Introduction to control problem**	Concept of feedback and Automatic control, Effects of feedback, Objectives of control system, Definition of linear and nonlinear systems, Elementary concepts of sensitivity and robustness. Types of control systems, Servomechanisms and regulators, examples of feedback control systems. Transfer function concept. Pole and Zeroes of a transfer function. Properties of Transfer function.	***International Academia:*** https://ocw.mit.edu/courses/2-04a-systems-and-controls-spring-2013/ ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Vol.%20I_UG.pdf ***Industry Mapping:*** Feedback and Automatic control, Servomechanisms and Regulators, Linear and Nonlinear systems	4	Determination of Step response for first order & Second order system with unity feedback with the help of CRO & calculation of control system specification , Time constant, % peak overshoot, settling time etc. from the response.	Linear control Systems, B.S.Manke,Khanna Publishers	1,2,3, 4,5
2	**Mathematical modelling of dynamic systems**	Translational systems, Rotational systems, Mechanical coupling, Liquid level systems, Electrical analogy of Spring–Mass-Dashpot system. Block diagram representation of control systems. Block diagram algebra. Signal flow graph. Mason's gain formula. Control system components: Potentiometer, Synchros, Resolvers, Position encoders. DC and AC tacho-generators. Actuators. Block diagram level description of feedback control systems for position control, speed control of DC motors, temperature control, liquid level control, voltage control of an Alternator.	***International Academia:*** https://ocw.mit.edu/courses/2-04a-systems-and-controls-spring-2013/ ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Vol.%20I_UG.pdf ***Industry Mapping:*** Translational systems, Rotational systems, Mechanical coupling, Liquid level systems, Electrical analogy of Spring–Mass-Dashpot system, Synchros, Resolvers, Position encoders. DC and AC tacho-generators. Actuators.	10	Familiarization with MAT-Lab control system tool box, MAT-Lab-simulink tool box & PSPICE	Linear control Systems, B.S.Manke, Khanna Publishers	6

3	**Time domain analysis**	Time domain analysis of a standard second order closed loop system. Concept of undamped natural frequency, damping, overshoot, rise time and settling time. Dependence of time domain performance parameters on natural frequency and damping ratio. Step and Impulse response of first and second order systems. Effects of Pole and Zeros on transient response. Stability by pole location. Routh-Hurwitz criteria and applications. Error Analysis: Steady state errors in control systems due to step, ramp and parabolic inputs. Concepts of system types and error constants.	***International Academia:*** https://ocw.mit.edu/courses/2-04a-systems-and-controls-spring-2013/ ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Vol.%20I_UG.pdf ***Industry Mapping:*** Error Analysis: Steady state errors in control systems due to step, ramp and parabolic inputs. Concepts of system types and error constants.	6	Simulation of Step response & Impulse response for type-0, type-1 & Type-2 system with unity feedback using MATLAB& PSPICE. Study of a practical position control system obtaining closed step responses for gain setting corresponding to over-damped and under-damped responses. Determination of rise time and peak time using individualized components by simulation. Determination of un-damped natural frequency and damping ration from experimental data.	Linear control Systems, B.S.Manke , Khanna Publishers	7
4	**Stability Analysis**	Root locus techniques, construction of Root Loci for simple systems. Effects of gain on the movement of Pole and Zeros. Frequency domain analysis of linear system: Bode plots, Polar plots, Nichols chart, Concept of resonance frequency of peak magnification. Nyquist criteria, measure of relative stability, phase and gain margin. Determination of margins in Bode plot. Nichols chart. M-circle and M-Contours in Nichols chart.	***International Academia:*** https://ocw.mit.edu/courses/2-04a-systems-and-controls-spring-2013/ ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Vol.%20I_UG.pdf ***Industry Mapping:*** Root Locus, Bode Plot, Polar plot, Nyquist criteria	10	Determination of Root locus, Bode plot, Nyquist plot using MATLAB control system tool box for 2nd order system& determination of different control system specification from the plot. Determination of approximate transfer functions experimentally from Bode plot.	Linear control Systems, B.S.Manke , Khanna Publishers	8

5	**Control System performance measure**	Improvement of system performance through compensation. Lead, Lag and Lead-lag compensation, PI, PD and PID control. Microprocessor and FPGA based control system, Instrumentation in control system, Digital control system and applications of control system.	***International Academia:*** https://ocw.mit.edu/courses/2-04a-systems-and-controls-spring-2013/ ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Vol.%20I_UG.pdf ***Industry Mapping:*** Controller Tuning, FPGA, Digital control system and applications of control system.	6	Determination of PI, PD and PID controller action of first order simulated process. Evaluation of steady state error, setting time, percentage peak overshoot, gain margin, phase margin with addition of Lead, Lag, Lead-lag compensator. Design of Lead, Lag and Lead-Lag compensation circuit for the given plant transfer function. Analyze step response of the system by simulation. Design of a DC motor speed controller using PID tuning method.	Linear control Systems, B.S.Manke, Khanna Publishers	9
6	**State variable Analysis**	Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.	***International Academia:*** https://ocw.mit.edu/courses/2-04a-systems-and-controls-spring-2013/ ***AICTE-prescribed syllabus:*** https://www.aicte-india.org/sites/default/files/Vol.%20I_UG.pdf ***Industry Mapping:*** Concepts of state variables. State space model	5	Determination of Transfer Function of a given system from State Variable model and vice versa. Analysis of a physical system by State variable and to obtain step response for the system by simulation. Study of State variable analysis using simulation tools. To obtain step response and initial condition response for a single input, two-output system in SV form by simulation	Linear control Systems, B.S.Manke, Khanna Publishers	15

Course outcome:

After completion of this course, the learners will be able to

CO1. Develop mathematical model of mechanical, electrical, thermal, fluid system and different control system components like servomotors, synchros, potentiometer, tacho-generators etc.
CO2. Analyze stability of LTI system using routh-hurtwitz (RH) criteria, root locus techniques in time domain and bode plot and nyquist technique in frequency domain.
CO3. Design different control law or algorithms like proportional control, proportional plus derivative(PD) control, proportional plus integration(PI) control, and proportional plus integration plus derivative (PID) control and compensators like lag, lead, lag-lead for LTI systems.
CO4. Apply state variable techniques for analysis of linear, nonlinear and discrete-time systems.

Suggested Learning Resources:

Text books:

1. Linear control Systems, B.S.Manke, Khanna Publishers

Reference books:

1. Automatic Control Systems, B.C. Kuo & F. Golnaraghi, 8th Edition,PHIModern Control Engineering, K. Ogata, 4th Edition, Pearson Education
2. Control System Engineering, I. J. Nagrath & M. Gopal. New Age International Publication.
3. Control System Engineering, D. Roy Choudhury, PHI
4. Control System Design, C. Goodwin Graham, F. Graebe F. Stefan, Salgado. E. Mario, PHI

Lesson Plan:
Module 1: Introduction to control problem Year 2025 (Faculty: ARIJITA DAS)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Concept of feedback and Automatic control, Effects of feedback
2	Objectives of control system, Definition of linear and nonlinear systems, Elementary concepts of sensitivity and robustness. Types of control systems, Servomechanisms and regulators, examples of feedback control systems
3	Transfer function concept. Pole and Zeroes of a transfer function. Properties of Transfer function.

Module 2: Mathematical modelling of dynamic systems, Year 2025 (Faculty: ARIJITA DAS)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Block diagram representation of control systems. Block diagram algebra.
2	Block diagram representation of control systems. Block diagram algebra.
3	Signal flow graph. Mason's gain formula.
4	Signal flow graph. Mason's gain formula.
5	Translational systems, Rotational systems, Mechanical coupling, Liquid level systems, Electrical analogy of Spring–Mass-Dashpot system.
6	Potentiometer, Synchros, Resolvers, Position encoders. DC and AC tacho-generators. Actuators. Block diagram level description of feedback control systems for position control, speed control of DC motors, temperature control, liquid level control, voltage control of an Alternator.

Module 3: Time domain analysis, Year 2025 (Faculty: ARIJITA DAS)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Time domain analysis of a standard second order closed loop system. Concept of undamped natural frequency, damping, overshoot, rise time and settling time. Dependence of time domain performance parameters on natural frequency and damping ratio.
2	Time domain analysis of a standard second order closed loop system. Concept of undamped natural frequency, damping, overshoot, rise time and settling time. Dependence of time domain performance parameters on natural frequency and damping ratio.
3	Step and Impulse response of first and second order systems. Effects of Pole and Zeros on transient response. Stability by pole location.
4	Step and Impulse response of first and second order systems. Effects of Pole and Zeros on transient response. Stability by pole location.
5	Routh-Hurwitz criteria and applications. Error Analysis
6	Routh-Hurwitz criteria and applications. Error Analysis
7	Steady state errors in control systems due to step, ramp and parabolic inputs. Concepts of system types and error constants.
8	Steady state errors in control systems due to step, ramp and parabolic inputs. Concepts of system types and error constants.

Module 4: Stability Analysis, Year 2025 (Faculty: ARIJITA DAS)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Effects of gain on the movement of Pole and Zeros.
2	Frequency domain analysis of linear system: Bode plots
3	Frequency domain analysis of linear system: Bode plots
4	Frequency domain analysis of linear system: Polar plots, Nichols chart
5	Frequency domain analysis of linear system: Polar plots, Nichols chart
6	Determination of margins in Bode plot. Nichols chart. M-circle and M-Contours in Nichols chart.

7	Concept of resonance frequency of peak magnification. Nyquist criteria, measure of relative stability, phase and gain margin.
8	Concept of resonance frequency of peak magnification. Nyquist criteria, measure of relative stability, phase and gain margin.
9	Root locus techniques, construction of Root Loci for simple systems.
10	Root locus techniques, construction of Root Loci for simple systems.

Module 5: Control System performance measure, Year 2025 (Faculty: ARIJITA DAS)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Improvement of system performance through compensation. Lead, Lag and Lead-lag compensation
2	PI, PD and PID control
3	PI, PD and PID control
4	Digital control system and applications of control system.
5	Digital control system and applications of control system.
6	Microprocessor and FPGA based control system, Instrumentation in control system

Module 6: State variable Analysis, Year 2025 (Faculty: ARIJITA DAS)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Concepts of state variables. State space model. Diagonalization of State Matrix.
2	Eigenvalues and Stability Analysis. Concept of controllability and observability.
3	Eigenvalues and Stability Analysis. Concept of controllability and observability.
4	Discrete-time systems. Difference Equations.
5	State-space models of linear discrete-time systems. Stability of linear discrete-time systems

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	0	1	1	0	0	0	1
CO2	3	3	2	2	2	1	1	1	0	0	0	1
CO3	3	3	2	2	2	0	1	1	0	0	0	1
CO4	3	2	2	2	2	1	0	1	0	0	0	1

University of Engineering and Management

Institute of Engineering & Management, Salt Lake Campus
Institute of Engineering & Management, New Town Campus
University of Engineering & Management, Jaipur

Syllabus and Lesson Plan for B.Tech Admission Batch 2023

Subject Name: Power Electronics **Credit: 3** **Lecture Hours: 38**

Subject Code: PCCEEE504

Maximum: 100 marks (Internal: 30 marks; External: 70 marks)

List of Faculty Members handling the Subject –

1. Rajat Shubhra pal

Pre-requisite: Analog Electronics

Course Objective:

The purpose of learning this course is

1. To understand the functioning and characteristics of power switching devices
2. To understand different triggering circuits and techniques of commutation of SCR
3. To understand the principle of operation of converters
4. To find external performance parameter of converters.
5. To analyze methods of voltage control, improvement of power factor and reduction ofharmonics of the converter

Course Outcome:

At the end of the course, the students will be able to:

CO1. Understand the differences between signal level and power level devices.
CO2. Construct triggering and commutation circuits of SCR.
CO3. Explain the principle of operation and analysis converters
CO4. Apply the concept to power control for different applications

Relevant Links:

Study Material	Coursera	NPTEL	Linkedin Learning	

Detailed Syllabus:

Module number	Topic	Mapping with Industryand International Academia	Lecture Hours	Corresponding Lab Assignment	Text Book	Mapped Chapter
1	**Introduction:** Concept of power electronics, application of power electronics, advantages and disadvantages of power electronics converters, power electronics systems,	***International Academia:*** (https://ocw.mit.edu/cour ses/6-334-power-electronics-spring-2007/) ***Industry Mapping:*** MATLAB	2	None	P.S. Bhimra, Power Electronics, Khanna Publishers, 3rd Edition	1

2	**Switching devices:** ideal switch, power diodes, power transistors, power MOSFET and IGBT. Thyristors, V-I characteristics of SCR. Two transistor model of SCR, SCR turn on methods, switching characteristics, gate characteristics, ratings, protection, series and parallel operation, gate triggering circuits, different commutation techniques of SCR	***International Academia:*** ***(https://ocw.mit.edu/cour ses/6-334-power- electronics-spring-2007/)*** ***Industry Mapping: MATLAB***	8	Performance parameter analysis of power semiconductor switches for designing inverters used in renewable energy systems Design different triggering circuit for controlling the voltage applied to motors enabling speed control in conveyor belts, elevators, and cranes. Design of firing circuits suitable for triggering SCR in a 1- phase full controlled bridge converter used in battery charging systems, enabling controlled DC output suitable for large industrial batteries	P.S. Bhimra, Power Electronics, Khanna Publishers, 3rd Edition	2,4,5

3	**Phase controlled converters**: Uncontrolled Rectifiers. Principle of operation of single phase and three phase half controlled, full controlled converters with R, R-L and RLE loads, effects of freewheeling diodes and source inductance on the performance of converters, dual converters. Performance parameters of converters, techniques of power factor improvement.	***International Academia:*** ***(https://ocw.mit.edu/cour ses/6-334-power- electronics-spring-2007/)*** ***Industry Mapping: PSIM, MATLAB***	10	Investigating the effect of load variation (purely R to R-L) using single phase controlled converter for heating control of appliances. Achieving precise and smooth lighting control using single phase controlled converter and verify the effect of source inductance on the output. Obtaining precise voltage control for BLDC motor using single phase half controlled symmetrical bridge converters. Regulation and control of reactive power flow using three phase controlled converter with load variation (purely R to R-L to purely L).	P.S. Bhimra, Power Electronics, Khanna Publishers, 3rd Edition	3,6

4	**DC-DC Converters**: Principle of operation, control strategies of choppers, concepts of duty ratio and average voltage, power circuit of a buck converter, Power circuit of a boost converter, types of choppers circuits based on quadrant of operation, performance parameters, analysis and waveforms at steady state, duty ratio control of output voltage. Study of Buck-Boost Converters and assessment of auto - transitional operating modes with AI based I/O & O/P applications, multiphase choppers	***International Academia: (https://ocw.mit.edu/cour ses/6-334-power- electronics-spring-2007/)*** ***Industry Mapping: PSIM, MATLAB***	6	Analysis of the buck-boost chopper performance in terms of voltage regulation and efficiency for charging batteries by stepping up or down the input voltage to match the battery's charging requirements, especially in industrial UPS systems. Integrating step up and step down chopper using IGBT with DC-DC charging station for solar panels and observing voltage variation.	P.S. Bhimra, Power Electronics, Khanna Publishers, 3rd Edition	7
5	**Inverters**: Definition, classification of inverters based on nature of input source, wave shape of output voltage, method of commutation & connections. Principle of operation of single phase and three phase bridge inverter with R and R-L loads, performance parameters of inverters, methods of voltage control and harmonic reduction of inverters. Pulse width modulation	***International Academia: (https://ocw.mit.edu/cour ses/6-334-power- electronics-spring-2007/)*** ***Industry Mapping: PSIM, MATLAB***	8	Analyze the effect of modulation index on the output voltage and frequency of a pulse width modulated bridge inverter used in EV drive systems to convert DC battery power to variable AC for motor operation, allowing efficient acceleration, deceleration, and speed control.	P.S. Bhimra, Power Electronics, Khanna Publishers, 3rd Edition	8
6.	**Applications**: Separately excited dc motor speed control, HVDC application, Static VAr controller, UPS, switch mode power supply, resonant converter	***International Academia: (https://ocw.mit.edu/cour ses/6- 334-power-electronics-spring-2007/)***	4		P.S. Bhimra, Power Electronics, Khanna Publishers, 3rd Edition	11

Lesson Plan:

Module 1: Introduction, Year: 3rd, (Faculty: Rajat Shubhra Pal)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Concept of power electronics, application of power electronics, advantages and disadvantages of power electronics converters,
2	Power electronics systems, ideal switch,
3	Power diodes, power transistors,
4	Power MOSFET and IGBT.
5	Single phase uncontrolled rectifiers.
6	Three phase uncontrolled rectifiers.

Module 2: PNPN devices, Year: 3rd, (Faculty: Rajat Shubhra Pal)

WORKING DAY	LESSON PLAN – DESCRIPTION
7	Thyristors, V-I characteristics of SCR. Two transistor model of SCR,
8	SCR turn on methods, switching characteristics, gate characteristics
9	SCR ratings, protection,
10	series and parallel operation,
11	Gate triggering circuits, Triggering using Micro-processor,
12	Different commutation techniques of SCR

Module 3: Phase controlled converters, Year: 3rd, (Faculty: Rajat Shubhra Pal)

WORKING DAY	LESSON PLAN – DESCRIPTION
13	Principle of operation of single phase and half controlled converters with R, R-L and RLE loads,
14	Principle of operation of single phase and full controlled converters with R, R-L and RLE loads,
15	Effects of freewheeling diodes on the performance of converters,
16	Principle of operation of three phase half controlled, full controlled converters with R, R-L and RLE loads,
17	Effects of source inductance on the performance of converters,
18	Dual converters.
19	Performance parameters of converters,
20	Techniques of power factor improvement.

Module 4: DC-DC Converters, Year: 3rd, (Faculty: Rajat Shubhra Pal)

WORKING DAY	LESSON PLAN – DESCRIPTION
21	Principle of operation, control strategies of choppers, concepts of duty ratio and average voltage,
22	Power circuit of a buck converter, Power circuit of a boost converter,
23	Types of choppers circuits based on quadrant of operation, performance parameters,
24	Analysis and waveforms at steady state, duty ratio control of output voltage.
25	Study of Buck-Boost Converters
26	Assessment of auto - transitional operating modes with AI based I/O & O/P applications, multiphase choppers

Module 5: Inverters, Year: 3rd , (Faculty: Rajat Shubhra Pal)

WORKING DAY	LESSON PLAN – DESCRIPTION
27	Definition, classification of inverters based on nature of input source,
28	Principle of operation of single phase and
29	Methods of voltage control and performance parameters of inverters,
30	Principle of operation of three phase bridge inverter with R loads 120 degree mode,
31	Principle of operation of three phase bridge inverter with R loads 180 degree mode,
32	Wave shape of output voltage, method of commutation & connections.
33	Pulse width modulation
34	harmonic reduction of inverters.

Module 6: Applications, Year: 3rd, (Faculty: Rajat Shubhra Pal)

WORKING DAY	LESSON PLAN – DESCRIPTION
35	Separately excited dc motor speed control,
36	HVDC application, Static VAr controller,
37	UPS, switch mode power supply,
38	Resonant converter

TEXT BOOK:

1. P.S. Bhimra, Power Electronics, Khanna Publishers, 3rd Edition
2. M.H. Rashid "Power Electronics", PHI, 2001

REFERENCE BOOKS:

1. V.R. Moorthi "Power Electronics", Oxford, 2005
2. M.D. Singh and K.B. Khanchandani, "Power Electronics", Tata Mc Graw Hill. 2007
3. J.P. Agarwal "Power Electronics systems", Pearson Education, 2006
4. Phillip T Krein "Element of power Electronics", Oxford, 2007

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	1	-	-	-	-	-	-	-	-	1
CO2	3	2	3	1	-	-	-	-	-	-	-	1
CO3	3	3	2	1	2	1	-	-	-	-	-	2
CO4	3	3	3	3	3	1	1	-	-	-	-	2

University of Engineering and Management

Institute of Engineering & Management, Salt Lake Campus
Institute of Engineering & Management, New Town Campus
University of Engineering & Management, Jaipur

Syllabus and Lesson Plan for B.Tech Admission Batch 2023-27

Subject Name: Electric Vehicles **Credit: 3** **Lecture Hours: 32**

Subject Code: PEC-EEE-571A

Maximum: 100 marks (Internal: 30 marks; External: 70 marks)

List of Faculty Members handling the Subject –

1. Dr. Sourav Das

Pre-requisite:

Course Objective:

1. To understand the basic difference between conventional and Hybrid vehicles.
2. To understand different configuration and control of Electric drives.
3. To understand energy storage system in Hybrid vehicles.
4. To understand different energy management strategies of Hybrid vehicles.
5. To solve numerical problems on the topics studied

Course Outcome:

CO1	Understand Core Concepts: Grasp the fundamentals of electric and hybrid vehicles, including powertrains, components, and energy storage systems.
CO2	Explain System Operations: Describe the working of key systems like battery management, motor control, and regenerative braking.
CO3	Apply Design Principles: Analyze and design vehicle systems focusing on performance, efficiency, and cost optimization.
CO4	Evaluate and Innovate: Compare technologies, identify improvements, and propose sustainable, integrated EV/HEV solutions.

Relevant Links:

Study Material	**Coursera Hyperlinked**	**Nptel**	**LinkedIn Learning:**	**Infosys Springboard:**

Detailed Syllabus:

Module number	Topic	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Text Book	Mapped Chapter
1.	Introduction: Introduction to Electric & Hybrid Electric Vehicles: History of hybrid and electric vehicles, efficiencies of electric & ICEs, classifications of hybrid vehicle powertrains, advantages & disadvantages of EVs and HEVs, social and environmental importance of hybrid and electric vehicles. Hybrid Engine systems: Basic concepts of hybrid ICEs, Power train components for HEV, Sensors in HEV, AI Based Cyber-Security for EV Technology	*International Academia:* https://ocw.mit.edu/courses/16-682-technology-in-transportation-spring-2011/pages/syllabus/ *AICTE prescribed syllabus:* https://www.aicte-india.org/sites/default/files/Model_Curriculum/fINAL%20-%20NEP%202020%20Model%20Syllabus%20for%20Open%20Electives%20in%20Electric%20Vehicles.pdf *Industry Mapping:* *AI mapping: Introduction to Automotive Cybersecurity & Vehicle Networks | Coursera*	8		J.D. Halderman & C. Ward, “Electric & Hybrid Electric Vehicles”, Pearson, 2023.	Chapter 2, 3 & 4

2.	EV & HEV Drive-trains: Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, DC Motor, Induction Motor control, Permanent Magnet Motor drives (BLDC, PMSM), motor-converter-inverter diagnostics, sizing the propulsion motor.	*International Academia:* https://ocw.mit.edu/courses/16-682-technology-in-transportation-spring-2011/pages/syllabus/ *AICTE prescribed syllabus:* https://www.aicte-india.org/sites/default/files/Model_Curriculum/fINAL%20-%20NEP%202020%20Model%20Syllabus%20for%20Open%20Electives%20in%20Electric%20Vehicles.pdf *Industry Mapping:*	8	1. Development of Solution Tools for Noise Reduction and Efficiency Enhancement in BLDC Motors under Forward, Reverse, and Braking Conditions in Electric Vehicles 2. Performance Evaluation of Electric Vehicle under Power Lock Condition 3. Performance Evaluation of Electric Vehicle without Power Lock Condition 4. Design and Analysis of Electric Vehicle Performance under Various Fault Conditions 5. Design of Intelligent Control Techniques of BLDC Motor Using Artificial Intelligence (AI).	J.D. Halderman & C. Ward, "Electric & Hybrid Electric Vehicles", Pearson, 2023.	Chapter 11
3.	Energy Storage & Charging Technology: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, low & high voltage batteries, different types of batteries (Li-ion, Ni-metal hybrid), battery management system, regenerative braking, electrical distribution system. EV & PHEV Charging: different levels of charging, EV charging equipment, wireless charging, electing the energy storage technology.	*International Academia:* https://ocw.mit.edu/courses/16-682-technology-in-transportation-spring-2011/pages/syllabus/ *AICTE prescribed syllabus:* https://www.aicte-india.org/sites/default/files/Model_Curriculum/fINAL%20-%20NEP%202020%20Model%20Syllabus%20for%20Open%20Electives%20in%20Electric%20Vehicles.pdf *Industry Mapping:*	10	1. Analysis of Charging and Discharging Characteristics of Lithium-Ion Battery Used in Electric Vehicles 2. Design and Implementation of Cell Balancing Techniques for Lithium-Ion Battery Packs in EV Applications 3. Designing Intelligent Charging Scheduling Techniques Using MATLAB Simulation Incorporating G2V and V2V Mode Of Operation	J.D. Halderman & C. Ward, "Electric & Hybrid Electric Vehicles", Pearson, 2023.	Chapter 9, 10, 12 & 13, 14, 19

4.	Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, different intelligent energy management strategies using AI, comparison of different energy management strategies, implementation issues of energy management strategies, CAN Network, AI based fault detection using CAN Network	*International Academia:* https://ocw.mit.edu/courses/16-682-technology-in-transportation-spring-2011/pages/syllabus/ *AICTE prescribed syllabus:* https://www.aicte-india.org/sites/default/files/Model_Curriculum/fINAL%20-%20NEP%202020%20Model%20Syllabus%20for%20Open%20Electives%20in%20Electric%20Vehicles.pdf *Industry Mapping:*	6	1. Development of Intelligent Energy Management Strategies for EV Charging in Distributed Energy Resources (DER), Integrated with Conventional Grids 2. Modeling various EV driving cycle attributes and essential parameter calculation Using MATLAB Simulation 3. Designing Intelligent Charging Scheduling Techniques Using MATLAB SIMULINK & Soft Computing incorporating G2V and V2G mode of operation	J.D. Halderman & C. Ward, “Electric & Hybrid Electric Vehicles”, Pearson, 2023.	Chapter 3: Energy Management Problem in HEVs
5.	Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).					Chapter 3: Energy Management Problem in HEVs

Lesson Plan:

Module 1: INTRODUCTION: 3rd Year, Sec A (Faculty : Prof. Dr. Sourav Das)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	The evolution of EVs and HEVs dates back to the 19th century, starting with early electric car innovations and later blending internal combustion engines with electric power.
2	Electric vehicles are significantly more energy-efficient (90%) than internal combustion engines (20-30%) due to reduced energy losses. Moreover discussion of HEV powertrains which are categorized as series, parallel, or series-parallel hybrids, based on the interaction between electric and combustion systems.
3	**Advantages of EVs and HEVs** and **Disadvantages of EVs and HEVs**: High initial costs, range limitations, battery disposal concerns, and insufficient charging infrastructure are notable drawbacks. Moreover, **Social and Environmental Importance of Hybrid and Electric Vehicles** which mitigate pollution, reduce greenhouse gas emissions, and encourage a shift towards cleaner, sustainable transportation systems.
4	HEVs combine combustion engines with electric systems for efficiency, using powertrains with motors, batteries, and sensors to optimize performance. AI-based cybersecurity protects EVs from threats and ensures system safety.

Module 2: EV & HEV Drive Train: 3rd Year, Sec A (Faculty : Prof. Dr. Sourav Das)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	The use of electric motors to propel vehicles, providing efficient and clean transportation.
2	Evaluation of the energy consumption and efficiency of electric drive-trains compared to traditional internal combustion engines.
3	Understanding key components like motors, inverters, and converters that are integral to hybrid and electric vehicles.
4	Use of induction motors, which are robust, efficient, and cost-effective for driving EVs, controlled through variable frequency drives.
5	Includes Brushless DC (BLDC) motors and Permanent Magnet Synchronous Motors (PMSM), known for high efficiency and compact design in EV applications.
6	Techniques for monitoring the performance of motors, converters, and inverters to ensure reliability and efficiency.
7	Determining the appropriate motor size based on vehicle requirements, such as power, torque, and energy efficiency, to optimize performance.
8	Analyzing the factors influencing motor choice for hybrid and electric vehicles, including power output, torque, efficiency, and cost.
9	Integration of regenerative braking systems within electric drive-trains to recover kinetic energy and improve overall efficiency.
10	Addressing the heat generation in motors, inverters, and converters, and implementing cooling solutions to maintain performance and longevity.
11	Exploring advanced control techniques such as vector control and direct torque control (DTC) to optimize motor performance and vehicle handling.

Module 3: ENERGY STORAGE & CHARGING TECHNOLOGY: 3rd Year, Sec A (Faculty : Prof. Dr. Sourav Das)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Understanding energy storage systems and analyzing batteries for capacity, efficiency, and lifecycle to ensure optimal performance and range in hybrid and electric vehicles.
2	Explore how fuel cells convert hydrogen into electricity, providing a clean and efficient energy storage solution for hybrid and electric vehicles.
3	Study low and high-voltage batteries, their applications based on vehicle power needs, and the characteristics of common EV batteries like Li-ion and Ni-metal hydride.
4	Study low and high-voltage batteries, their applications based on vehicle power needs, and the characteristics of common EV batteries like Li-ion and Ni-metal hydride.
5	Understand the role of the Battery Management System in monitoring, optimizing battery performance, and ensuring safety and longevity in hybrid and electric vehicles.
6	Learn how regenerative braking recovers energy during deceleration and recharges the battery, enhancing overall vehicle efficiency.
7	Explore how electrical distribution systems manage power flow for efficient vehicle operation and the various charging levels, from home outlets to fast chargers, used for EVs.
8	: Understand how wireless charging uses electromagnetic fields for cable-free energy transfer and how to select the appropriate energy storage technology based on vehicle type, range, and cost considerations.

Module 4: ENERGY MANAGEMENT STRATEGIES: 3rd Year, Sec A (Faculty : Prof. Dr. Sourav Das)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Introduction to energy management approaches for hybrid and electric vehicles, focusing on optimizing power flow between energy sources.
2	Explore AI-driven strategies for dynamic and efficient energy management in hybrid and electric vehicles.
3	Analyze and compare various energy management techniques, evaluating their strengths and weaknesses.
4	Discuss the challenges involved in implementing energy management strategies in real-world hybrid and electric vehicles.
5	Understand the role of the Controller Area Network (CAN) in enabling communication between vehicle components for efficient operation.
6	Learn how AI utilizes data from the CAN network for real-time fault detection and system optimization.
7	Study the design process and components involved in creating a Hybrid Electric Vehicle (HEV).
8	Analyze the design of a Battery Electric Vehicle (BEV), focusing on battery selection, motor systems, and energy management.

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	2	1	2	1	0	1	1	2
CO2	3	3	2	2	2	1	2	1	1	2	1	2
CO3	3	3	3	3	3	2	2	1	2	2	2	3
CO4	3	3	3	3	3	3	3	2	2	3	3	3

TEXT BOOK:

1. J.D. Halderman & C. Ward, “Electric & Hybrid Electric Vehicles”, Pearson, 2023.
2. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.

REFERENCE BOOKS:

1. M. Ehsani, Y. Gao, S. E. Gayand A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.
2. T. Denton, “Electric and Hybrid Vehicles”, Routledge, 2016.

University of Engineering and Management

Institute of Engineering & Management, Salt Lake Campus
Institute of Engineering & Management, New Town Campus
University of Engineering & Management, Jaipur

Syllabus for B.Tech Admission Batch 2023

Subject Name: Renewable & Non Conventional Energy
Subject Code: PEC-EEE-571B

Credit: 3 **Lecture Hours: 42**

Maximum: 100 marks (Internal: 30 marks; External: 70 marks)

List of Faculty Members handling the Subject –

1. Pratik De Sarkar

Pre-requisite: Basic Electronics

Course objectives:

The purpose of learning this course is

1. To understand the difference between Renewable and non-renewable energy sources
2. To understand methods of conversion of solar energy and wind energy to other form of energy
3. To understand methods harnessing energy from Biomass, Geothermal and ocean
4. To understand the principle of operation of Magneto Hydrodynamic power generation
5. To understand the principle and operation of fuel cell
6. To solve numerical problems of Renewable and non-renewable energy sources

Course outcomes:

At the end of the course, the students will be able to

CO1: Explain the principle of conversion of solar energy, wind energy, biomass, Geothermal energy, Ocean energy, Hydrogen energy to other form of energy and magneto hydrodynamic power generation.
CO2: Use Solar energy, Wind energy, Biomass, Geothermal energy, Ocean energy, Hydrogen energy and fuel cell for different applications to set up wind mill and biogas generation plant
CO3: Estimate conversion efficiency of fuel cell, solar energy, wind energy, ocean energy and hydrogen energy to heat and electric energy.
CO4: Solve numerical problems relating to conversion of solar energy, Wind energy, Biomass, Ocean energy and Hydrogen energy to heat and electric energy

Relevant Links:

Study Material	Coursera	LinkedIn learning	Nptel	Infosys Springboard

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Text Book	Mapped Chapter
1	Introduction to Energy sources	Renewable and non-renewable energy sources, energy consumption as a measure of Nation's development; strategy for meeting the future energy requirements Global and National scenarios, Prospects of renewable energy sources. Impact of renewable energy generation on environment, Kyoto Protocol	International Academia: https://ocw.mit.edu/courses/22-081j-introduction-to-sustainable-energy-fall-2010/ Industry Mapping: MATLAB	3	1. Monitoring the health and performance of electric vehicle (EV) battery systems to ensure optimal operation, extend battery life, and support efficient energy management in automotive and fleet management applications (Hardware and MATLAB simulation).	Non-conventional Energy sources, G.D. Rai, 6th Edition, Khanna Publishers, 2017	1

2	Solar Energy	Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, storage of solar energy-thermal storage, solar pond , solar water heaters, solar distillation, solar still, solar cooker, solar heating & cooling of buildings, photo voltaics - solar cells, different types of PV Cells, Mono-poly Crystalline and amorphous Silicon solar cells. Design of PV array. Efficiency and cost of PV systems & its applications. PV hybrid systems.	International Academia: https://ocw.mit.edu/courses/ec-s07-photovoltaic-solar-energy-systems-fall-2004/ Industry Mapping: Atlas Homer PVsyst SolarEdge	10	1. Performance Evaluation of Solar PV Panel using I-V and P-V Characteristics for PV Module Testing under Standard Test Conditions (STC) to ensure quality and compliance with international standards (Hardware and MATLAB simulation) 2. Optimizing the Maximum Power Point (MPP) to achieve maximum efficiency for supplying industrial loads by utilizing series and parallel combinations of solar PV panels, ensuring reliable and cost-effective renewable energy solutions in industrial applications (Hardware and MATLAB simulation). 3. Design a solar plant yielding maximum energy considering the variation of solar irradiance throughout the day for supplying the variable load (Hardware and MATLAB simulation). 4. Design a solar plant yielding maximum energy considering proper placement and orientation of solar PV module for supplying the variable load (Hardware and MATLAB simulation). 5. Analyze the effect of	Renewable energy resources and emerging technologies, D.P. Kothari, 2nd Edition, PHI	3, 4, 5, 6

					the bypass diode on the PV module so that stable voltage and current levels is maintained in grid-tied systems by minimizing power disruptions caused by partial shading 6. Analyze the behavior of PV module by varying radiation and intensity for catering the load demand (Hardware and MATLAB simulation). 7. Analyzing the impact of varying loads on the performance of a solar and grid-tied inverter system to ensure efficient power delivery, optimal load management, and seamless grid integration in real-world applications (Hardware and MATLAB simulation). 8. Design a single-phase grid tied inverter for solar PV application in MATLAB Simulink.		
3	Wind Energy	Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; various types of Generators used for wind energy conversion, design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations	International Academia: https://ocw.mit.edu/courses/ec-711-d-lab-energy-spring-2011/video_galleries/wind-micro-hydro/ Industry Mapping: OpenFAST Bladed	10	1. Performance evaluation of a wind plant to analyze the impact of wind speed and ensure efficient power generation (Hardware and MATLAB simulation).	Non-conventional Energy sources, G.D. Rai, 6th Edition, Khanna Publishers, 2017	6

4	Energy from Biomass	Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantages, constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of bio gas, utilization of biogas	International Academia: https://ocw.mit.edu/courses/2-60j-fundamentals-of-advanced-energy-conversion-spring-2020/resources/mit2_60s20_lec24/ Industry Mapping: TRNSYS	4		Renewable Energy Sources and Emerging Technologies, D.P. KOTHARI, PHI, Second Edition, 2011	12
5	Geothermal Energy	Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India	International Academia: https://ocw.mit.edu/courses/2-60j-fundamentals-of-advanced-energy-conversion-spring-2020/resources/mit2_60s20_lec18/ Industry Mapping: GEOPHIRES	3		Non-conventional Energy sources, G.D. Rai, 6th Edition, Khanna Publishers, 2017	8
6	Energy from Ocean	Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India. Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy	International Academia: https://ocw.mit.edu/courses/22-081j-introduction-to-sustainable-energy-fall-2010/resources/mit22_081jf10_lec03a/ Industry Mapping: MATLAB	3		Non-Conventional Energy Resources, B. H. Khan, 3rd Edition, Mc Graw Hill	10
7	Hydrogen Energy	Introduction, Hydrogen Production methods, Hydrogen storage, hydrogen transportation, utilization of hydrogen gas, hydrogen as alternative fuel for vehicles	International Academia: https://ocw.mit.edu/courses/2-61-internal-combustion-engines-spring-2017/resources/mit2_61s17_lec21/ Industry Mapping: FCS3000 Fuel Cell Simulation Software	3		Non-Conventional Energy Resources, B. H. Khan, 3rd Edition, Mc Graw Hill	12

Lesson Plan:

Module 1: Introduction to Energy sources   Year 2025, (Faculty : Mr. Pratik De Sarkar)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Renewable and non-renewable energy sources, energy consumption as a measure of Nation's development;
2	Strategy for meeting the future energy requirements Global and National scenarios, Prospects of renewable energy sources.
3	Impact of renewable energy generation on environment, Kyoto Protocol

Module 2: Solar Energy   Year 2025, (Faculty : Mr. Pratik De Sarkar)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation
2	local solar time, derived solar angles, sunrise, sunset and day length.
3	flat plate collectors, concentrating collectors Solar air heaters-types, solar driers,
4	storage of solar energy-thermal storage,
5	solar pond , solar water heaters, solar distillation,
6	solar still, solar cooker, solar heating & cooling of buildings,
7	photo voltaics - solar cells, different types of PV Cells,
8	Mono-poly Crystalline and amorphous Silicon solar cells
9	Design of PV array. Efficiency and cost of PV systems & its applications. PV hybrid systems.

Module 3: Wind Energy   Year 2025, (Faculty : Mr. Pratik De Sarkar)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Principle of wind energy conversion;
2	Basic components of wind energy conversion systems;
3	wind mill components,
4	various types and their constructional features;
5	various types of Generators used for wind energy conversion,
6	design considerations of horizontal and vertical axis wind machines:
7	analysis of aerodynamic forces acting on wind mill blades and
8	estimation of power output;
9	wind data and site selection considerations

Module 4: Energy from Biomass   Year 2025, (Faculty : Mr. Pratik De Sarkar)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Biomass conversion technologies, Biogas generation plants,
2	classification, advantages and disadvantages, constructional details,
3	site selection, digester design consideration, filling a digester for starting,
4	maintaining biogas production, Fuel properties of bio gas, utilization of biogas

Module 5: Geothermal Energy   Year 2025, (Faculty : Mr. Pratik De Sarkar)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal,
2	Geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy,
3	prospects of geothermal energy in India

Module 6: Energy from Ocean   Year 2025, (Faculty : Mr. Pratik De Sarkar)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India.
2	Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy.
3	Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy

Module 7: Magneto Hydrodynam ic power generation   Year 2025, (Faculty : Mr. Pratik De Sarkar)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Principle of MHD power generation, MHD system,
2	Design problems and developments, gas conductivity,
3	materials for MHD generators and future prospects

Module 8: Hydrogen Energy   Year 2025, (Faculty : Mr. Pratik De Sarkar)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Introduction, Hydrogen Production methods,
2	Hydrogen storage, hydrogen transportation, utilization of hydrogen gas,
3	hydrogen as alternative fuel for vehicles

Module 9: Fuel cell   Year 2025, (Faculty : Mr. Pratik De Sarkar)

WORKING DAY	LESSON PLAN – DESCRIPTION
1	Introduction, Design principle and operation of fuel cell,
2	Types of fuel cells,
3	conversion efficiency of fuel cell,
4	application of fuel cells

Suggested Learning Resources:

Text Books:

1. Renewable energy resources and emerging technologies, D.P. Kothari, 2nd Edition, PHI
2. Non-conventional Energy sources, G.D. Rai, 6th Edition, Khanna Publishers
3. Non-Conventional Energy Resources, B. H. Khan, 3rd Edition, Mc Graw Hill

Reference Books:

1. Renewable energy sources and conversion technology, Bansal Keemann, Meliss, Tata Mc Graw Hill.
2. Energy Technology, O.P. Gupta, Khanna Publishing House.
3. Non-conventional Energy, Ashok V. Desai, New Age International Publishers Ltd
4. Non-conventional Energy sources, Chandra, Khanna Publishing House.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1	2	0	0	3	0	0	0	0	0	0
CO 2	3	3	2	2	2	3	3	0	0	0	0	1
CO 3	3	3	3	3	2	2	2	0	1	0	0	1
CO 4	3	2	0	3	0	0	2	0	0	0	0	0

University of Engineering and Management

Institute of Engineering & Management, Salt Lake Campus
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University of Engineering & Management, Jaipur

Syllabus and Lesson Plan for B.Tech Admission Batch 2023-2027

Subject Name: AI & ML **Credit: 3** **Lecture Hours: 40**

Subject Code: OEC-EEE 501A

Maximum: 100 marks (Internal: 30 marks; External: 70 marks)

List of Faculty Members handling the Subject –

1. Prof. Dr. Tanmay Sinha Roy

Pre-requisite: (1) Design and Analysis of Algorithms, Data Structures and Algorithms (2) Basic concepts from Mathematics & Statistics (Linear Algebra, and Statistics and Probability, Calculus) (3) Programming in Python/R

Course Objectives:

1. To introduce the concept of Classical Artificial Intelligence techniques and agents to achieve desired objectives.
2. To introduce and familiarize the students with the various searching algorithms relevant for Artificial Intelligence.
3. Introduce and apply the concepts of Knowledge Representation and Reasoning methodologies.
4. Introduce the details of the various planning techniques important for building artificial intelligence systems
5. Introduce Expert Systems using the concepts of representing and usage of domain knowledge in the respective areas of applications.
6. To understand how Machine learning techniques are used to make computers learn from from data and experience, a vast variety of application areas, from spam filters, medical imaging, analyze customer purchase data, or to detect fraud in credit card transactions.
7. To discover patterns in your data and then make predictions based on often complex patterns to answer business questions, detect and analyse trends and help solve problems.
8. To understand and appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and unsupervised learning and be able to design and implement various machine learning algorithms in a range of real-world application.

Course Outcomes:

CO1: Understand the basic concepts and techniques of Artificial Intelligence and Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.

CO2: Apply AI algorithms for solving practical problems, using tools of logic and knowledge representation

CO3: Planning - planning with state space search, partial order, graphs, with propositional logic, Analysis of planning approaches, Hierarchical planning, conditional planning, Continuous and Multi Agent planning

CO4: Explain Expert System and implementation and be able to design and implement various machine learning algorithms in a range of real-world application

Relevant Links:

Study Material	Coursera Hyperlinked	Nptel	LinkedIn Learning:	Infosys Springboard:

Detailed Syllabus:

Module number	Topic	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Text Book	Mapped Chapter
1	**Introduction** Artificial Intelligence and its applications, Components of Artificial Intelligence (AI), Artificial Intelligence Techniques, Level of models, criteria of success, Intelligent Agents, Nature of Agents, Learning Agents, advantages and limitations of AI, Impact and Examples of AI, Application domains of AI.	**AICTE prescribed syllabus:** https://www.aicteindia.org/sites/default/files/UG_Eme rging.pdf International Academia: **(1) MIT:** https://ocw.mit.edu/courses/6034 artificial intelligencefall 2010/resources/lecture 1introduction and scope/Industry (2) **Stanford Univ.:** https://stanford-cs221.github.io/spring2024/ **IITs:**	4		Artificial Intelligence - by Rich and Knight (McGraw Hill)	Chapter-1

		1. **IIT Kanpur**: https://cse.iitk.ac.in/users/cs365/2008/syllabus.html 2. **IIT Bombay:** **https://www.cse.iitb.ac.in/~siva/talks/cs621intro.pdf** **https://www.ieor.iitb.ac.in/acad/courses/ie703** **Coursera** **https://www.coursera.org/learn/introduction-to-ai** **Nptel** **https://nptel.ac.in/courses/106102220**				Artificial Intelligence – by Saroj Kaushik (Cengage)	
2	**AI Search & Optimization Algorithms** *Uninformed Search Algorithms* Depth First Search, Breadth-First Search, Depth-Limited Search, Uniform Cost Search. *Informed Search Algorithms* Greedy Search Algorithm, A* Search Algorithms, Graph Search. *Local Search Algorithms* Tabu Search, Hill Climbing Algorithms, Simulated Annealing, Genetic Algorithms, Local Beam Search. *Swarm Intelligence Algorithms* Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO), Artificial Bee Colony (ABC) Algorithm. *Adversarial Search Algorithms* Minimax Algorithm, Alpha-Beta Pruning.	**AICTE prescribed syllabus:** https://www.aicteindia.org/sites/default/files/UG_Eme rging.pdf International Academia: **(1) MIT:** https://ocw.mit.edu/courses/6034 artificial intelligencefall 2010/resources/lecture 1introduction and scope/Industry (2) **Stanford Univ.:** https://stanford-cs221.github.io/spring2024/ **IITs:** 3. **IIT Kanpur**: https://cse.iitk.ac.in/users/cs365/2008/syllabus.html 4. **IIT Bombay:** **https://www.cse.iitb.ac.in/~siva/talks/cs621intro.pdf** **https://www.ieor.iitb.ac.in/acad/courses/ie703** **Coursera** **https://www.coursera.org/learn/introduction-to-ai** **Nptel** **https://nptel.ac.in/courses/106102220**	12			Artificial Intelligence and Soft Computing – by Amit Konar (CRC Press)	Chapter-4

3	**Introduction to Machine Learning** Defining machine learning, its types (supervised, unsupervised, reinforcement), and its applications. Neural Networks Perceptron, Single Layer Perceptron, Multilayer Perceptron, Classifier Evaluation, Ensemble Learning, Boosting.	**Coursera** https://www.coursera.org/specializations/machine-learning-introduction **Nptel** https://nptel.ac.in/courses/106106139	8		Machine Learning - Tom Mitchell (TM) (publ. by McGraw Hill) Pattern Classification - Duda, Hart and Stork (DHS) (Wiley, 2nd edn.)	TM, DHS Chapter-1 DHS Chapter-2, 3, 6, 7, 8, 9.
4	**Supervised and Unsupervised Machine Learning Algorithms** Decision Tree, Bayesian Networks, Bayes Classifier, Linear Regression, Logistic Regression, k-Nearest Neighbour Learning, Support Vector Machines, Random Forest Classifier. Clustering, K-Means Clustering Dimensionality Reduction, Reinforcement Learning.	**Coursera** https://www.coursera.org/specializations/machine-learning-introduction **Nptel** https://nptel.ac.in/courses/106106139	12		Machine Learning - Tom Mitchell (TM) (publ. by McGraw Hill) Pattern Classification - Duda, Hart and Stork (DHS) (Wiley, 2nd edn.)	DHS Chapter-3, 5, 6. 9, 10 TM Chapter-4, 5, 13.
5	**Introduction to Deep Learning** Kernels in CNN Model, Hyper-Parameters, CNN Model Architecture, AlexNet, LeNet, VGG Networks, Google Network, Residual Networks.	**Coursera** https://www.coursera.org/specializations/deep-learning **Nptel** https://nptel.ac.in/courses/106105215	4		Artificial Intelligence and Soft Computing – by Amit Konar (CRC Press)	

Lesson Plan:

Module 1: Introduction to Artificial Intelligence and its applications: 3rd Year, (Faculty : Prof. Dr. Tanmay Sinha Roy)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Artificial Intelligence and its applications, Components of Artificial Intelligence.
Day 2	Artificial Intelligence Techniques, Level of models, criteria of success, Intelligent Agents.
Day 3	Nature of Agents, Learning Agents, advantages and limitations of AI.
Day 4	Impact and Examples of AI, Application domains of AI.

Module 2: AI Search & Optimization Algorithms: 3rd Year, (Faculty : Prof. Dr. Tanmay Sinha Roy)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Uninformed Search Algorithms-Depth First Search
Day 2	Breadth-First Search, Depth-Limited Search
Day 3	Uniform Cost Search
Day 4	Informed Search Algorithms- Greedy Search Algorithm
Day 5	A* Search Algorithms, Graph Search
Day 6	Local Search Algorithms-Tabu Search
Day 7	Hill Climbing Algorithms
Day 8	Simulated Annealing, Genetic Algorithms (GAs)
Day 9	Swarm Intelligence Algorithms-Ant Colony Optimization (ACO)
Day 10	Particle Swarm Optimization (PSO), Artificial Bee Colony (ABC) Algorithm, Local Beam Search
Day 11	Adversarial Search Algorithms-Minimax Algorithm
Day 12	Alpha-Beta Pruning.

Module 3: Introduction to Machine Learning: 3rd Year, (Faculty : Prof. Dr. Tanmay Sinha Roy)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Machine Learning Fundamentals, Learning Paradigms
Day 2	Concept Learning
Day 3	Decision Tree
Day 4	Bayes Classifier
Day 5	Bayesian Networks
Day 6	Linear Regression, Logistic Regression
Day 7	Computational Learning Theory
Day 8	k-Nearest Neighbour Learning
Day 9	Support Vector Machines
Day 10	Random Forest Classifier

Module 4: Neural Networks Perceptron: 3rd Year, (Faculty : Prof. Dr. Tanmay Sinha Roy)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Neural Networks Perceptron- Introduction.
Day 2	Multilayered Perceptron
Day 3	Classifier Evaluation
Day 4	Ensemble Learning
Day 5	Boosting
Day 6	supervised Learning
Day 7	Unsupervised Learning
Day 8	Clustering
Day 9	Dimensionality Reduction
Day 10	Reinforcement Learning

Module 5: Introduction to Deep Learning: 3rd Year, (Faculty : Prof. Dr. Tanmay Sinha Roy)

WORKING DAY	LESSON PLAN – DESCRIPTION
Day 1	Deep Learning- Fundamentals
Day 2	Kernels in CNN Model, Hyper-Parameters
Day 3	CNN Model Architecture, AlexNet, LeNet, VGG Networks
Day 4	Google Network, Residual Networks.

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	0	1	1	0	0	0	1
CO2	3	3	2	2	2	1	1	1	0	0	0	1
CO3	3	3	2	2	2	0	1	1	0	0	0	1
CO4	3	2	2	2	2	1	0	1	0	0	0	1

TEXT BOOK:

1. Artificial Intelligence - by Rich and Knight (McGraw Hill)
2. Artificial Intelligence – by Saroj Kaushik (Cengage)
3. Artificial Intelligence and Soft Computing – by Amit Konar (CRC Press)
4. Machine Learning - Tom Mitchell (TM) (publ. by McGraw Hill)
5. Pattern Classification - Duda, Hart and Stork (DHS) (Wiley, 2nd edn.)

REFERENCE BOOKS:

6. Artificial Intelligence and Machine Learning - by Vinod Chandra S.S. (PHI Learning, 1st edn., 2014)
7. Artificial Intelligence by Padhy, (Oxford University Press, 2005)
8. A First Course in Artificial Intelligence – by Deepak Khemani (McGraw Hill, 2013)
9. Artificial Intelligence by Nils J. Nilsson (Elsevier India; First Ed, 2003)
10. Introduction to Machine Learning - **E. Alpaydin (EA)** (publ. MIT Press, 3rd edn.)
11. The Elements of Statistical Learning - **Hastie, Tibshirani, Friedman (HTF)** - (publ. Springer, 2nd edn.)
12. Understanding Machine Learning: From Theory to Algorithms - **Shai Shalev- Shwartz and Shai Ben-David**, (publ. Cambridge University Press)
13. Pattern Recognition and Machine Learning - **Christopher Bishop** (publ. Springer)

University of Engineering and Management

Institute of Engineering & Management, Salt Lake Campus
Institute of Engineering & Management, New Town Campus
University of Engineering & Management, Jaipur

Syllabus and Lesson Plan for B.Tech Admission Batch 2023

Subject Name: Computer Organisation **Credit: 3**
Lecture Hours: 3 **Subject Code: OEC-EEE 501B**

Maximum: 100 marks (Internal: 30 marks; External: 70 marks)

List of Faculty Members handling the Subject –

1.

Pre-requisite: (1) Design and Analysis of Algorithms, Data Structures and Algorithms (2) Basic concepts from Mathematics & Statistics (Linear Algebra, and Statistics and Probability, Calculus) (3) Programming in Python/R

Course Objective:

To expose the students to the following:

CO1: How Computer Systems work & the basic principles
CO2: The current state of art in memory system design
CO3: How I/O devices are accessed and its principles.
CO4: To provide the knowledge on Instruction Level Parallelism

Course Outcome:

Upon completion of this course, students should be able to:

1. Student will learn the concepts of computer organization for several engineering applications.
2. Student will develop the ability and confidence to use the fundamentals of computer organization and tool in the engineering of digital systems.
3. An ability to identify, formulate, and solve hardware and software computer engineering problems usingsound computer engineering principle.
4. To impart the knowledge on micro programming and comprehend the concepts of advanced pipelining techniques.

Relevant Links:

	Coursera Hyperlinked	**Nptel**	**LinkedIn Learning:**	**Infosys Springboard:**

Detailed Syllabus:

Module number	Topic	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Text Book	Mapped Chapter
1	**Introduction:** Basic organization of the stored program in computer and operation sequence for execution of a program. Role of operating systems and compiler/ assembler. Fetch, decode and execute cycle. Concept of operator, operand, registers and storage. Instruction format. Instruction sets and addressing modes. Commonly used number systems. Fixed and floating point representation of numbers.	Academic Mapping: CTE Model Curriculum for (aicte-india.org) **Industry Mapping:**	10		Computer Organization – Carl Hamacher, Zvonks Vranesic, SafeaZaky, Vth Edition, McGraw Hill.	Ch 1, 2

2	**Overflow and underflow.** Design of address- ripple carry and carry look ahead principles. Design of ALU Fixed point multiplication-Booth's algorithm Fixed point division-Restoring and non restoring algorithms. Floating point-IEEE 754 standard.	Academic Mapping: CTE Model Curriculum for (aicte-india.org) **Industry Mapping:**	10		Computer Systems Architecture – M.Moris Mano, 3rd Edition, Pearson/PHI	Ch3, Ch 10
3	**Memory unit design And Memory Organization:** Memory unit design with special emphasis on implementation of CPU-memory interfacing. Memory organization. Static and dynamic memory, memory hierarchy, associative memory. Cache memory. Virtual memory. Data path design for read/write access.	Academic Mapping: CTE Model Curriculum for (aicte-india.org) **Industry Mapping:**	10		Computer Organization – Carl Hamacher, Zvonks Vranesic, SafeaZaky, Vth Edition, McGraw Hill. Computer Systems Architecture – M.Moris Mano, 3rd Edition, Pearson/PHI	Ch 5, 6 Ch 12
4	**Pipelining and Input- output organization:** Design of control unit-hardwired and micro programmed control. Introduction to instruction pipelining. Introduction to RISC architecture, RISC vs. CISC architecture. I/O operations-Concepts of handshaking. Polled I/O, Interrupt and DMA.	Academic Mapping: CTE Model Curriculum for (aicte-india.org) **Industry Mapping:**	10		Computer Organization – Carl Hamacher, Zvonks Vranesic, SafeaZaky, Vth Edition, McGraw Hill. Computer Systems Architecture – M.Moris Mano, 3rd Edition, Pearson/PHI	Ch 1, 8 Ch 8

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	0	1	1	0	0	0	1
CO2	3	3	2	2	2	1	1	1	0	0	0	1
CO3	3	3	2	2	2	0	1	1	0	0	0	1
CO4	3	2	2	2	2	1	0	1	0	0	0	1

TEXT BOOK:

1. Computer Organization – Carl Hamacher, Zvonks Vranesic, SafeaZaky, 5th Edition, McGraw Hill.
2. Computer Systems Architecture – M.Moris Mano, IIIrd Edition, Pearson/PHI

REFERENCE BOOKS:

1. "Computer Architecture and Organization", 3rd Edition by John P. Hayes,WCB/McGraw-Hill
2. "Computer Organization and Architecture: Designing for Performance", 10th Edition by i. William Stallings, Pearson Education.
3. "Computer System Design and Architecture", 2nd Edition by Vincent P. Heuring and Harry ii. F. Jordan, Pearson Education.

SMS group

INDUSTRIAL AUTOMATION CURRICULAM

5th Semester

Sl. No.	Topics	No. of Lectures	Remarks
	TOTAL	**30**	**1 hr duration for each session**
1	**INTRODUCTION**	**1**	
1.1	Introduction & Ice Breaking	1	
1.2	What is Automation?		
1.3	Levels of Automation System		
1.4	Architecture of Industrial Automation System		
1.5	Requirements & uses of Automation Systems		
2	**BASICS OF DIGITAL ELECTRONICS**	**2**	
2.1	Numbering System	1	
2.2	Gates		
2.3	Flip-flops (Mainly SR Flip-Flops)		
2.4	Timers & Counters	1	
2.5	Data Types & Conversion		
3	**COMPONENTS OF INDUSTRIAL AUTOMATION SYSTEM**	**7**	
3.1	Programmable Controllers & Power Supply	1	
3.2	Sensors, Actuators, IO Devices (RIO, VVVF Drives etc.)	1	
3.3	Computer Hardware (Programming Unit, HMI etc.) & System Software	1	
3.4	Networking Components	1	
3.5	SCADA/HMI	1	
3.5	Basics of Electrical Equipment (Motors, MCC, Contactors, Relays etc.)	2	
4	**INPUTS FOR AN AUTOMATION SYSTEM**	**5**	
4.1	Introduction to Engineering	1	
4.2	Process & Instrument Diagram (P&ID)		
4.3	Process Flow Diagram (PFD)	1	
4.4	Motor & Component List	1	
4.5	Instrument List		
4.6	Signal List/IO List		
4.7	Local Control Desk/Local Control Station	1	
4.8	Functional Description	1	
5	**BASICS OF LEVEL 1 AUTOMATION PROGRAMMING**	**15**	
5.1	Significance of Programming	1	
5.2	Concept of Structured Programming		
5.3	Programming Languages	1	
5.4	Exposure to Simple Programming (Binary and digital operations) in LAD	6	1 Theory + 5 Practical Sessions
5.5	Exposure to Simple Programming (Binary and digital operations) in FBD	7	1 Theory + 6 Practical Sessions

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Syllabus for B.Tech Admission Batch 2023

Name of the Course/ Subject	**ELECTRIC MACHINE II LABORATORY**	**Subject Code:**	**PCC-EEE-591**
Semester	**V**	**Course Nature**	**Practical**
Pre-Requisite(s):	Basic Electrical Engineering Lab (ES-EE-191), Electric Machine-I Lab (PC-EEE-491)		
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
0	**0**	**3**	**1**

Course objectives:

The purpose of learning this course is

1. To enable, train and evaluate the ability of the students to perform the analysis of any electromechanical system.
2. To empower students to determine the parameters of AC, DC machines and transformers by performing experiments on these machines.
3. To enable students to identify and solve AC, DC machine and Transformer related problems.
4. The ability to select a suitable measuring instrument for a given application.

Detailed Syllabus

Module No.	Description	No of period
1	Application of different starter for maintaining the stable operation of a 3 phase Cage Induction Motor [DOL, Auto transformer & Star-Delta].	3
2	Design of an 18 slot squirrel cage Induction motor for 6 poles & 4 pole operation in full pitch & fractional slot winding diagram.	3
3	Speed control of 3 phase squirrel cage induction motor by different methods & their comparison [voltage control & frequency control] for industrial application.	3
4	Test of single phase induction motor for centrifugal pump application.	3
5	Design the equivalent circuit of single phase induction motor for different domestic application.	3
6	Evaluate the performance characteristics of wound rotor Induction motor for industrial hoist application.	3
7	Design a equivalent circuit for synchronous machine for analyzing the machine performance using industrial testing procedure [Direct axis resistance (Xd) & Quadrature reactance (Xq)].	3
8	Performance verification of Induction generator for wind mill application.	3
9	Determination of voltage regulation of Synchronous machine by a. Synchronous Impedance method at different power factor.	3
10	PLC and AC Drive based speed control of induction motor with Human Machine Interface.	3
11	Evaluate the optimize performance criteria for different industrial load application of Synchronous motor using V-curve method.	3

Virtual Lab. Details:

Sl No.	Experiment Name	Web-Link/Software Used
1	Different methods of starting of a 3 phase Cage Induction Motor & their comparison [DOL, Auto transformer & Star-Delta).	http://vemjitg.vlabs.ac.in/Stator%20Resistance%20Starter(intro).html http://vem-iitg.vlabs.ac.in/Auto%20Transformer%20Starting(intro).html http://vem-iitg.vlabs.ac.in/Star%20Delta%20Starting(intro).html
2	Speed control of 3 phase slip ring Induction motor by resistance control. rotor	https://ems-iitr.vlabs.ac.in/exp/speed-control-slip-ring/
3	Determination of regulation of Synchronous machine by a. Potier reactance method. b. Synchronous Impedance method.	https://em-coep.vlabs.ac.in/exp/open-circuit-phase-alternator/simulation.html https://em-coep.vlabs.ac.in/exp/short-circuit-phase-alternator/simulation.html
4	V-curve of Synchronous motor.	https://em-coep.vlabs.ac.in/exp/synchronous-motor/simulation.html

Laboratory outcome:

After completion of this course, the learners will be able to

LO1. Identify appropriate equipment and instruments for the experiment.

LO2. Test the instrument for application to the experiment.
LO3. Construct circuits with appropriate instruments and safety precautions.
LO4. Validate different characteristics of single phase Induction motor, three phase Induction motor, Induction generator and synchronous motor , methods of speed control of Induction motors and parallel operation of the 3 phase Synchronous generator.

Simulation based Experiments :

1. Design a simulation model for determining the characteristics of Self Excited Induction Generator in MATLAB Simulink

2. Design a simulation model for evaluating the optimal characteristics of Three Phase Induction Motor Controlled by AC Voltage Controller in MATLAB Simulink

3. Design a MATLAB Simulation model for 3 phase Induction Motor Torque Speed Characteristics.

Suggested Learning Resources:

1. Laboratory experiments on Electrical Machines, C.K. Chanda, A. Chakrabarti, Dhanpat Rai & Co.
2. Laboratory manual for Electrical Machines, D.P. Kothari, B.S.Umre, I K International Publishing House Pvt. Ltd.

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Syllabus for B.Tech Admission Batch 2023

Name of the Course/ Subject	**CONTROL SYSTEM LABORATORY**	**Subject Code:**	**PCCEEE592**
Semester	**V**	**Course Nature**	**Practical**
Pre-Requisite(s):	1. Basic Electrical Engineering 2. Electric Circuit Theory 3. Electric Machine-I		
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
0	**0**	**3**	**1**

Course Objective(s):

The purpose of learning this course is to-

1. Mathematically model various systems and study their responses.
2. Successfully use modern IT tools to study the characteristics of different systems.
3. Study stability of various control systems.
4. To work effectively in a team

Detailed Syllabus

Module No.	Description	No of period
1	Familiarization with MAT-Lab control system tool box, MAT-Lab-simulink tool box & PSPICE	3
2	Determination of Step response for first order & Second order system with unity feedback with the help of CRO &calculation of control system specification, Time constant, % peak overshoot, settling time etc. from the response.	3
3	Simulation of Step response & Impulse response for type-0, type-1 & Type-2 system with unity feedback using MATLAB& PSPICE.	3
4	Determination of Root locus, Bode plot, Nyquist plot using MATLAB control system tool box for 2nd order system& determination of different control system specification from the plot.	3
5	Determination of PI, PD and PID controller action of first order simulated process.	3
6	Determination of approximate transfer functions experimentally from Bode plot.	3
7	Evaluation of steady state error, setting time, percentage peak overshoot, gain margin, phase margin with addition of Lead, Lag, Lead-lag compensator.	3
8	Study of a practical position control system obtaining closed step responses for gain setting corresponding to over-damped and under-damped responses. Determination of rise time and peak time using individualized components by simulation. Determination of un-damped natural frequency and damping ration from experimental data.	3
9	Design of Lead, Lag and Lead-Lag compensation circuit for the given plant transfer function. Analyze step response of the system by simulation.	3
10	Determination of Transfer Function of a given system from State Variable model and vice versa. Analysis of a physical system by State variable and to obtain step response for the system by simulation.	3
11	Study of State variable analysis using simulation tools. To obtain step response and initial condition response for a single input, two-output system in SV form by simulation	3
12	PID controller tuning for dc motor speed control.	3

Course Outcomes:

At the end of this course, students will be able to demonstrate

1. Mathematically model electrical and mechanical systems and derive their transfer functions and use relevant IT tools such as MAT-Lab control system tool box, MAT-Lab- Simulink tool box & PSPICE for simulation and finding out solution of a problem. Do interfacing design of peripherals like I/O, A/D, D/A, timer etc.
2. Evaluate the stability of different control systems and design various controllers (P, I, PID etc) for a given application.
3. Validate step response & impulse response for type-0, type-1 & Type-2 system with unity feedback using MATLAB & PSPICE.
4. To build leadership quality working in a team to construct the experiment, identify the variables and finding out the solution of a given problem using appropriate IT tools and interpret the experimental data to generate a proper report.

Suggested Learning Resources:

1. Control System Design, C. Goodwin Graham, F. Graebe F. Stefan, Salgado. E. Mario, PHI
2. Modeling & Control of dynamic system, Macia&Thaler, Thompson

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Syllabus for B.Tech Admission Batch 2023

Name of the Course/ Subject	Power Electronics Laboratory	**Subject Code:**	PCCEEE593
Semester	**V**	**Course Nature**	**Practical**
Pre-Requisite(s):	Basic Electronics, Analog Electronics		
Lecture Periods/Week	**Tutorial Periods/Week**	**Practical Periods/Week**	**Credits**
0	0	3	1

Course Objective(s):

The purpose of learning this course is-

1. To identify the basic elements of the power electronics engineering
2. To understand the basic operation of different power converter
3. To design different power converter for specific application.

Laboratory Experiments

Experiment No.	Description	No of period
1.	Performance parameter analysis of power semiconductor switches for designing inverters used in renewable energy systems	3
2.	Design different triggering circuit for controlling the voltage applied to motors enabling speed control in conveyor belts, elevators, and cranes.	3
3.	Design of firing circuits suitable for triggering SCR in a 1- phase full controlled bridge converter used in battery charging systems, enabling controlled DC output suitable for large industrial batteries	3
4.	Investigating the effect of load variation (purely R to R-L) using single phase controlled converter for heating control of appliances.	3
5.	Obtaining precise voltage control for BLDC motor using single phase half controlled symmetrical bridge converters.	3
6.	Analysis of the buck-boost chopper performance in terms of voltage regulation and efficiency for charging batteries to match the battery's charging requirements used in industrial UPS systems.	3
7.	Implement a three phase bridge inverter for star connected lamp load intensity control.	3
8.	Achieving precise and smooth lighting control using single phase controlled converter and verify the effect of source inductance on the output.	3
9.	Integrating step up and step down chopper using IGBT with DC-DC charging station for solar panels and observing voltage variation.	3
10.	Analyze the effect of modulation index on the output voltage of a pulse width modulated bridge inverter used in EV drive systems.	3
11.	Regulation and control of reactive power flow using three phase controlled converter with load variation (purely R to R-L to purely L).	3

Course Outcomes:

At the end of this course, students will demonstrate the ability to

CO1. Identify the basic elements of the power electronics engineering.

CO2. Understand the basic operation of electronic switches.

CO3. Understand the operation of different types of power converter.

CO4. Design basic converter for various applications

Suggested Learning Resources:

1. P.S. Bhimra, “Power Electronics”, Khanna Publishers
2. M.H. Rashid “Power Electronics Handbook”, Academic Press
3. Timothy L. Skveranina, “The Power Electronics Handbook”, CRC Press
4. R.S. Ramshaw, **“**Power Electronics Semiconductor Switches”, Springer-Science
5. Farzin Asadi, Kei Eguchi, “Power Electronics Circuit Analysis with PSIM”, De Gruyter

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Syllabus for B.Tech Admission Batch 2023

Name of the Course/ Subject	Electric Vehicles Laboratory	**Subject Code:**	PECEEE591A
Semester	**V**	**Course Nature**	**Practical**
Pre-Requisite(s):	Basic Electrical Engineering Lab, Electric Circuit Theory Lab		
Lecture Periods/Week	**Tutorial Periods/Week**	**Practical Periods/Week**	**Credits**
0	0	3	1

List of the experiments:

Sl. No	Hardware Experiment	No. of periods
1.	Development of Solution Tools for Noise Reduction and Efficiency Enhancement in BLDC Motors under Forward, Reverse, and Braking Conditions in Electric Vehicles	3
2.	Analysis of Charging and Discharging Characteristics of Lithium-Ion Battery Used in Electric Vehicles	3
3.	Design and Implementation of Cell Balancing Techniques for Lithium-Ion Battery Packs in EV Applications	3
4.	Performance Evaluation of Electric Vehicle under Power Lock Condition	3
5.	Performance Evaluation of Electric Vehicle without Power Lock Condition	3
6.	Design and Analysis of Electric Vehicle Performance under Various Fault Conditions	3
7.	Designing Intelligent Charging Scheduling Techniques Using MATLAB Simulation Incorporating G2V and V2V Mode Of Operation.	3
8.	Designing Intelligent Charging Scheduling Techniques Using MATLAB SIMULINK & Soft Computing incorporating G2V and V2G mode of operation.	3
9.	Development of Intelligent Energy Management Strategies for EV Charging in Distributed Energy Resources (DER), Integrated with Conventional Grids	3
10.	Design of Intelligent Control Techniques of BLDC Motor Using Artificial Intelligence (AI).	3

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Name of the Course/ Subject	Renewable & Non-Conventional Energy Lab	**Subject Code:**	PECEEE591B
Semester	**V**	**Course Nature**	**Practical**
Pre-Requisite(s):	Basic Electrical Engineering Lab, Electric Circuit Theory Lab		
Lecture Periods/Week	**Tutorial Periods/Week**	**Practical Periods/Week**	**Credits**
0	0	3	1

Course objectives:

The purpose of learning this course is

1. To understand the different concepts of Renewable & Non-Conventional Energy like Wind & Solar
2. To understand the different operational behavior changes with different controlling parameters of renewable sources.
3. To understand the different controlling parameters for battery storage systems.
4. To understand the concept of developing a simulation model for renewable sources.

Detailed Syllabus

Experiment No	Experiment Name	No of period
1	Performance Evaluation of Solar PV Panel using I-V and P-V Characteristics for PV Module Testing under Standard Test Conditions (STC) to ensure quality and compliance with international standards (Hardware and MATLAB simulation)	3
2	Optimizing the Maximum Power Point (MPP) to achieve maximum efficiency for supplying industrial loads by utilizing series and parallel combinations of solar PV panels, ensuring reliable and cost-effective renewable energy solutions in industrial applications (Hardware and MATLAB simulation).	3
3	Design a solar plant yielding maximum energy considering the variation of solar irradiance throughout the day for supplying the variable load (Hardware and MATLAB simulation).	3
4	Design a solar plant yielding maximum energy considering proper placement and orientation of solar PV module for supplying the variable load (Hardware and MATLAB simulation).	3
5	Analyze the effect of the bypass diode on the PV module so that stable voltage and current levels is maintained in grid-tied systems by minimizing power disruptions caused by partial shading	3
6	Analyze the behavior of PV module by varying radiation and intensity for catering the load demand (Hardware and MATLAB simulation).	3
7	Performance evaluation of a wind plant to analyze the impact of wind speed and ensure efficient power generation (Hardware and MATLAB simulation).	3
8	Analyzing the impact of varying loads on the performance of a solar and grid-tied inverter system to ensure efficient power delivery, optimal load management, and seamless grid integration in real-world applications (Hardware and MATLAB simulation).	3
9	Monitoring the health and performance of electric vehicle (EV) battery systems to ensure optimal operation, extend battery life, and support efficient energy management in automotive and fleet management applications (Hardware and MATLAB simulation).	3
10	Design a single-phase grid tied inverter for solar PV application in MATLAB Simulink.	3

Course outcomes:

After completion of this course the learners will be able to

1. Remember the working principle of solar cell and wind turbine.
2. Apply the concept of charging and discharging to monitor the health of EV battery system.
3. Evaluate the effect of different loads in a solar and grid-tie inverter system.
4. Create a MATLAB simulation to draw the I-V and P-V characteristics of the PV module.

Suggested Learning Resources:

1. **Workbook**
2. **NPTEL**
3. **Linkedin Learning**
4. **Coursera**
5. **Infosys Springboard**

QUESTION PAPER PATTERN AND DATES

EXAMINATION	Dates	PART – A	PART – B	PART – C	TOTAL MARKS
Mid Term 1		Attempt 5 out of 10 questions; Each question carries 2 marks (2 × 5)	Attempt 2 out of 4 questions; Each question carries 5 marks (5 × 2)	Attempt 1 out of 2 questions; Each question carries 10 marks (10 × 1)	**30**
Mid Term 2		Attempt 5 out of 10 questions; Each question carries 2 marks (2 × 5)	Attempt 2 out of 4 questions; Each question carries 5 marks (5 × 2)	Attempt 1 out of 2 questions; Each question carries 10 marks (10 × 1)	**30**
End Semester Examination		Attempt 10 out of 15 questions; Each question carries 2 marks (2 × 10)	Attempt 6 out of 9 questions; Each question carries 5 marks (5 × 6)	Attempt 5 out of 8 questions; Each question carries 10 marks (10 × 5)	**100**

Examination Rules & Regulations:

https://iemcollege-my.sharepoint.com/:b:/g/personal/iemcoe_office_iem_edu_in/EXrcoe3d6oxIogHKO074XeUBC9qm3XNaf_qUeSiVTNh5OQ?e=MMQn40